

BOOSTER TUNING

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A study has been made of various distributions of tuning quadrupoles with a view to assessing the aperture requirements for a tuning range  $6.1 \leq \beta_{H,V} \leq 6.9$ .

The cases considered were those having superperiodicity  $S = 24, 12$  and  $8$ . In the case of  $S = 12$ , the phase advance per superperiod ( $2\pi/\gamma S$ ) is so close to  $\pi$  when the tuning is for  $\gamma = 6.1$  that the beating becomes prohibitive. (Factors of 2 to 3 in beam radius). Thus the remaining possibilities are  $S = 24$  or  $S = 8$ . Naturally the beating and quadrupole strengths required for  $S = 8$  are larger than those for  $S = 24$ .

One possibility suggested by Aisy van Steenbergen is to employ 24 pairs of quadrupoles for tuning at injection and 8 pairs at ejection. Table 1 shows the <sup>maximum</sup> increase in beam radius which occurs at injection for the two cases.

Table 1  
Maximum Beam radius increase at Injection.

S	F Magnet		D Magnet		$(KL)_{max}$ $(m^{-1})$
	H	V	H	V	
24	1.5 mm	1.0 mm	1.5 mm	0.4 mm	0.203
8	9.6 mm	4.3 mm	7.6 mm	4.8 mm	0.06

These figures have been computed using the 'FOCPAR' program and correspond to  $E_H = 50\pi$ ,  $E_V = 20\pi \mu\text{m}$ . and  $\frac{\delta p}{p} = \pm 2.5 \times 10^{-3}$ .

It is clear from Table 1 that the extra aperture required for  $S=8$  would not be justified by the reduction in the number of components. Also, since  $Kl \times S$  is about the same, the power supply requirements are similar. For a quadrupole length  $l = 0.3\text{m}$ , with 24 pairs, the maximum gradient required for the full tuning range at ejection is  $24.5 \text{ Kg/m}$ . Since the radial aperture required is  $\leq 8\text{cm}$ , the peak field at the edge of the aperture is less than  $2\text{Kg}$ .

Thus, by utilising a pair of tuning quads in each period, the full tuning range can be reached without difficulty and there would be little to be gained by providing a separate  $S=8$  tuning facility for ejection.

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